Royal United Services Institution. Journal

ISSN: 0035-9289 (Print) (Online) Journal homepage: http://www.tandfonline.com/loi/rusi19

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To cite this article: Rear-Admiral Sir Charles Campbell K.C.M.G., C.B., D.S.O. (1906) The Organisation of a Modern Fleet for War; Conduct in Action, Etc., Etc Former Papers (1872, 1880, & 1887) Brought up to Date, Royal United Services Institution. Journal, 50:346, 1445-1476, DOI: 10.1080/03071840609431327

To link to this article: http://dx.doi.org/10.1080/03071840609431327

Published online: 11 Sep 2009.

THE ORGANISATION OF A MODERN FLEET FOR WAR; CONDUCT IN ACTION, ETC., ETC

FORMER PAPERS (1872, 1880, & 1887) BROUGHT UP TO DATE.

By Rear-Admiral Sir CHARLES CAMPBELL, K.C.M.G., C.B., D.S.O.

Thursday, 24th May, 1906.

Admiral Sir NATHANIEL BOWDEN-SMITH, K.C.B., in the Chair.

INTRODUCTION.

THE 1872 paper was written in competition for the prize offered by the Junior Professional Association, and is quoted to-day as evidence that five-and-thirty years ago I was a strong advocate for "fitting the fleet-ship with a means of defence against torpedoes, supplying her with auxiliary torpedo-boats and a tender in which nothing but speed, turning power, and torpedo fittings have been considered, etc."

The 1880 paper was written in competition for the R.U.S.I. Gold Medal, and further accentuated the necessity for adjuncts and auxiliaries as part of the composition of a fleet.

The 1887 paper had for its object the complete abandonment of masts and sails for propulsion and the systematic organisation of adjuncts and auxiliaries as part of and to accompany future divisions, squadrons, and fleets for the purpose of war. Such portions of these efforts as seem useful have been embodied in this paper for discussion to-day.

The sails have gone for good and all, and only sufficient masts and yards remain temporarily for the purpose of "fire control" and communication by signal. It is therefore needless to dwell on that portion of the 1887 suggestions.

On the other hand, the statement as to "the revolutionary state of things which is going on in everything connected with a floating fight," still holds good, and has been confirmed by a recent experience in Eastern waters. I may therefore repeat "that what was good and proper yesterday is obsolete and condemned to-day, and who knows that to-morrow may not call into existence some new subaqueous or aërial machine which will make it necessary to build ships that will float bottom upwards, or on some other system contrary to the patterns in office."

Since the above words were written, under-water navigation has come to stay, aërial navigation is well above the horizon, and has become one of the possible weapons of future naval warfare; and internal combustion engines are in existence and rapidly growing!

I concluded the paragraph by adding: "Under these circumstances, in regulating the interior economy of present and future divisions, squadrons, and fleets, we must strive our utmost not only to keep pace with the inventions of the day and ahead of all maritime Powers, but to organise and exercise in keeping with adopted inventions, so as to be able to use them with greater effect than any maritime Power; and above all, when anything connected with the fighting capabilities, propulsion, or exercise of the units or their component parts is condemned and proved to be bad, root it out, and have done with it!"

I now suggest that the time has come to substitute telescopic masts with wireless platforms for communication without tops or yards, and so do away entirely with exposed above-deck gun fire. These masts would be telescoped below the armour while within range, their wireless senders, receivers, and platforms coming down and being stowed away beside them in comparative safety.

This decrease or abolition of "above-deck target" would bring your fire control down to the highest level of the deck structure, and you could utilise the weight saved by constructing a fire-control armoured tower in touch with all the guns. It is courting disaster to risk the demolition of your fire control early in the action; some system must be perfected that will give it the best chance of remaining effective until the adversaries' guns have been silenced! The idea of an Eifel Tower structure for fire control and spotting is equally bad on account of exposure, and the same may be said of utilising the boats' cranes.

The one aim and object of all spotting is to get an instantaneous communication from the spotter to the sight setter. It needs little or no demonstration to accentuate the necessity for rapidity! Was the last projectile a hit? How much over or short or to right or left? And how soon can the sight setter know the plunge position?

The unfortunate predicament in which we are placed by the present system is that it requires an elaborate bag of tricks in the shape of conduct wires and instruments which must be placed in the most probable path of the adversaries' projectiles, and whose principal necessity is height above deck.

The enormous risk of destruction at long range leads us to the investigation of other possible methods of obtaining the maximum of efficiency with the minimum risk of early destruction. The problem, put shortly, resolves itself into the following questions and answers:—

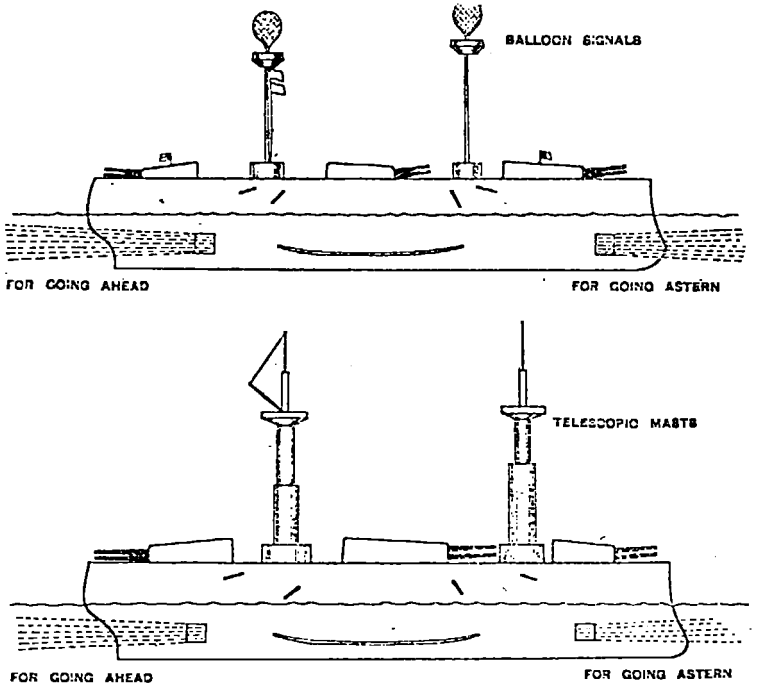
1. Can the sight setter get the elevation required by his own observation at long range? Answer: No.
2. How can he best get the range quickly and its changes continually? Answer: By having independent "squadron spotters" ahead and astern of the adversary, one for each fleet-ship.

The unit scout could perform this duty, keeping her parent informed by prearranged simple ball and cone signal. In addition, each ship should carry two captive balloons to observe the direction and as far as possible spot the elevation. These balloons would also carry halliards for hoisting signals. Free air-ships, when perfected, and capable of accurate navigation, would be most useful in spotting; but by that time, if the "conquest of the air" advances at its present rate, the "water-ship" will have assumed the *rôle* of the *sparrow*, and the "air-ship" that of the *hawk*.

I would also suggest that no boats should be taken into action! They should be hoisted out and sent to the various auxiliaries told off to look after them during action, who would hoist them on to positions specially fitted to receive them.

The boat cranes should be fitted so that after the boats are out they can be lowered into the lowest possible comparative safety position.

I hope and believe that it will be possible before long to do away with the funnels. At present the two most probable solutions of the problem of dispensing with funnels seem to lay between a system of utilising the wasted energies of coal to obtain power, and a system of propulsion without fires, substituting in the latter case explosive force, as already used in motor cars and boats under the name of internal combustion. I do not profess to be able to perfect such explosive engines for large ships; but I have made a rough sketch



Direct Action Internal Combustion

FIG. 1.

(Fig. 1) of what I maintain is wanted, and I make a present of the suggestion to any mechanical genius who has the talent and energy to improve upon it and bring it to perfection.

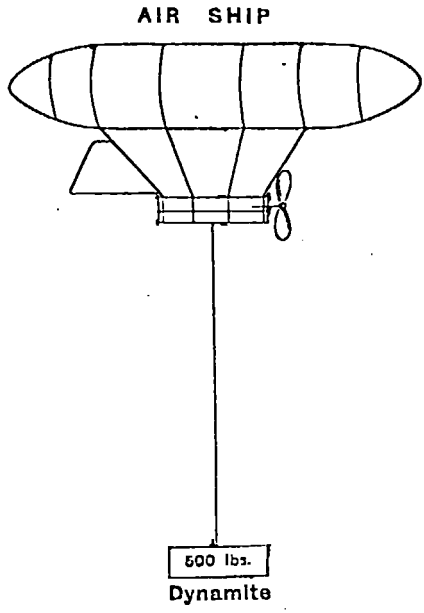
The effort would be on the same principle as the push of the oar or paddle-wheel, or thrust of the screw, namely, to push water against water, only the action would be direct. We have long had a velocity of 1,700 feet a second in the war rocket by forcing air against air. Surely there are chemical possibilities by which we may attain as

great, if not greater, speed by forcing water against water. Of one thing we may be certain, and that is, that the funnels are quite as sinful to-day as the sails were twenty years ago, and their removal is vitally important. The absence of boilers, funnels, and coal would greatly assist the much-needed reduction of complement in a fleet-ship, both in officers and men, and it would be another instance of the irony of fate if the present controversies on education, rank and position ended in effacement.

Besides the enormous advantage of having your propulsion completely below the water-line, you would be in a position to devise a means by which you could render the ship unsinkable. For instance, each compartment would be connected by pipe and valve with the cylinder sluice-well between the cylinder and the driving aperture, so that the action of the thrust would clear leaky compartments of water. Just consider for one moment the space gained by some such system, which would become available for ammunition and fuel, and the reduction of internal weight caused by the absence of boilers and steam machinery, together with the removal of the funnels as targets for the opponents' shot and shell.

The steering could be accomplished by giving the cylinder and driving tube a lateral motion to the right and left, or possibly by fitting two side propulsors at right angles to the keel. Going astern would present some difficulty, but if no better way could be discovered you could have two smaller bow tubes, one on each bow, which would close automatically on going ahead.

If no one is prepared to work on this suggestion, there are other already existing ways by which internal-combustion engines can be used for propulsion in fleet-ships, as also in passenger and cargo boats, and surely the vast gain both for war and commercial purposes would make it well worth the development of the idea by an inventive genius. In 1887 I was criticised by a talented officer then commanding afloat for treating the turbine engine as an accepted form of propulsion. He stated in the discussion: "At all events, it has not proved itself hitherto a factor on which we can rely, and therefore the lecturer has drawn, to a certain extent, on what he thinks may be possible in the future, rather than what is possible in the present." Now that is what I conceive is the duty of every lecturer who is asked to read a paper on a given subject in this theatre. Study historical retrospect and watch closely the trend of the inventions of home and foreign genius; bring the line up to date, and then endeavour to forecast the direction of future improvement. That, to my mind, spells progress. As you cannot obtain one glimpse of the future except through the medium of a reflected past, study the past; then predict, and act on your predictions. That is the duty of those entrusted with the fearful responsibility for the safety of these little islands and their big dependencies. All I wish to predict to-day is, that "internal-combustion engines," oil, gas, or chemical, will grow in size and number, and will eventually become the motive power for the purposes of commerce and war, and that in the long run, air fleets will be a serious menace to "water fleets," and may eventually replace them. I was just as certain in 1887 that the "turbine" was the engine of the future in large vessels for war or trade as I am to-day that "internal-combustion engines" will gradually be used by ships of ever-increasing tonnage; that masts and funnels must go for good and all; and that aëroplanes and navigable air-ships for war and



5,000 yards

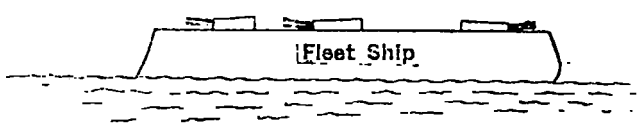


FIG. 2.

travelling are surely attaining a position which entitles them to serious consideration.

In the meantime Mr. Thomas A. Edison threatens us with a system of control of the wasted energies of coal, which he estimates will take a liner across the Atlantic in three days on a tenth of the present expenditure. As the funnels exist for the sole purpose of drawing the wasted energies and discharging them into the air, it follows that if no energy is wasted no funnels are required.

He also supports the practicability of using the aëriel microbe for the wholesale destruction of the "mammoth fleet-ships," and proposes to drop a dynamite shell (Fig. 2) anywhere within a mile or two of, and so pulverise, the hostile vessel.

Surely the "conquest of the air" is a serious menace to "sea power," and we may ere long be discussing the tactics of an air battle!

Fleet-ships.

The question of designing and building "fleet-ships," and, I may say, the question of their existence, has not escaped the universal controversy which eternally surrounds naval problems, and various solutions have been suggested from time to time. Twenty years ago there were not wanting officers and other experts of high repute and sound judgment who argued, with considerable ability and apparently on reliable *data*, that the days of the "fleet-ship" were numbered, and that swift sea-going torpedo craft were capable of making a clean sweep of them.

During the interval, notwithstanding the fact that the underwater "microbe" has continued to develop and has to be seriously considered, in addition to the above-water members of its family, and the gradual development of the air-ship, there is nothing so marked during the last decade, both at home and abroad, as the steady growth of tonnage, speed, and gun power of the "fleet-ship" (mammoth).

For example, in 1887 I quoted the "Dreadnought" as tactically the most powerful "fleet-ship" on the Mediterranean station. The "twenty years cycle," which is estimated by home and foreign authority as the extreme limit of the life of a "fleet-ship," has brought into existence a new "Dreadnought," with speed that, twenty years ago, would have been considered high for a swift cruiser, and gun power that would sink two of her earlier namesakes in a very short space of time, with but very little damage to herself, and a feature of unsinkableness which it is hoped will render her impervious to microbic attack! And finally a displacement which should largely augment her capacity for carrying fuel and ammunition per inch of immersion.

So that, without taking up your time with details of the ever-increasing tonnage, speed, and gun power of our sixty built and proposed "fleet-ships," I may take the example quoted as fairly typical, and use it as evidence in support of the correctness of my contention in 1887, where I stated:—

"We are assured, both on home and foreign authority, that the 'microbe' is to eat away the 'mammoth' from off the seas; but I am inclined to think that it will be some years yet before the microbe can act without the mammoth as a base. As long as you have to carry monster guns to attack forts and shell arsenals, so long must you have monster carriages (*i.e.*, fleet-ships) in which to transport them. So that the action of the mammoth and the microbe must be blended

for mutual support in the unit, division, squadron, and fleet of the future."

During the time that has elapsed since the above statement was made there is nothing so remarkable as the prominence that has been given to "gun power" by the naval architects and ordnance committees of all maritime nations, together with the strenuous and laudable efforts which have been made by all concerned in perfecting the British Navy so as to insure the huge and crushing projectile hitting the object aimed at, even at the comparatively enormous ranges at which practice is now carried out. Ships may vary in the excellence of their target practice, but there is not a shadow of a doubt that the standard of shooting has been raised in an equal if not in a greater ratio than the increase in gun power.

It is this combination of power and accuracy that has robbed the ram of the destructive powers attributed to it, and placed the torpedo in the second category of weapons for fleet attack and defence, while it has raised the gun to a position where it has at present no rival as the destructive weapon best suited for the annihilation of the adversary.

In my earlier efforts to deal with this question, notably in the essay of 1880, it will be seen that, while in favour of the use of gun power during the approach, I was distinctly of opinion at that time that the ram held a most important, if not the first place in a naval battle. My statement was: "The general principle on which every captain would fight his ship would be to try and disable his enemy by making the best of his artillery fire; making it very uncomfortable for those who are guiding his opponent's movements, trying to penetrate his vital parts, and blow up his magazine, damage his engines or screw, and generally speaking, to give him as little time for cool consideration as possible. . . ." At the same time, I added: "Each captain must be ready for the one aim and object of all naval actions of the present day (1880), 'The fatal blow with the ram!' To avoid the enemy's ram and run your own deep into his side, is the one end and aim of tactical skill, and the best captain is he who attains that very desirable object in the shortest possible time" And I devoted four pages in order to substantiate my contention.

Though still convinced that the ram honestly held the position universally accorded to it 25 years ago, I unhesitatingly declare that under the crushing effect of the gun as developed to-day, it has no longer a place in a "fleet ship," as affecting the result of a naval battle. The same arguments may be advanced with reference to the torpedo as an offensive weapon in action, and I may say that I have never given the torpedo a very prominent place in considering its value in a fleet action, discharged from the "Fleet ship." The only use it could be put to would be as a means of defence, when the ship has become stationary, owing to disabled machinery or screw, and even under such a distressing *contretemps* I would prefer to rely on the gun. On the other hand, I am far from deprecating the value of the torpedo as a weapon in action, discharged from swift destroyers, organised as auxiliaries to the "Fleet-ship." On the contrary, I have always maintained and still maintain that they are indispensible, especially in a night action. I assert then to-day, and challenge contradiction, "that the gun and its protection and accurate discharge, together with a sufficient quantity of fuel and ammunition, are the

all-important considerations for the success of a fleet in action." There seems every reason to believe that notwithstanding the recent advance, ships and guns for fleet work will still grow. As I wrote in 1880: "If we judge of the future by the past, what monsters must pass in review before our imagination." And I added: "'Qui uti scit ei bona' may well be said of guns, and a thorough knowledge of how to use them in a fleet action will be *half* the battle." After twenty-five years' further experience, I would only alter the last phrase to "*All* the battle." The guns have grown, and the knowledge of "how to use them" may be estimated from the returns of the gun layers' and other competitions for 1905.

Another point consequent on the growth of ships and guns, is the necessity for larger docks, both at home and foreign stations. Twenty thousand ton platforms to carry guns of forty calibres and over, means a strain on docking accommodation, but depend upon it that the docks must and will grow to the ships, and from what we read, a move is being made in that direction.

Imperial Organisation of the Navy, Distribution of Force, etc.

In the 1887 paper I stated that "There is a tendency to speak of the British fleet as a whole. This is quite wrong and misleading, and I for one should like to see the practice discontinued. . . Both in the past and at present we have always had numerous bodies of ships, sometimes called squadrons, sometimes fleets, which composed the navy; so that without proposing any radical change, I may suggest that we should have a definite number of divisions, squadrons, and fleets 'fixed and fitted for use,' their nomenclature depending on their numerical strength in units. Thus a division would consist of three units under a rear-admiral or commodore; a squadron, six units, under a senior rear-admiral or vice-admiral; and a fleet, twelve units, under an admiral; each unit, division, squadron or fleet having its told-off adjuncts and auxiliaries, as shown in the diagrams, and a distinct letter, number, or other designating sign of its own, which should be carried by all the component parts belonging to it." To-day I am more than ever convinced that the organisation of the unit is imperative, and that we must learn to speak of fleets, squadrons, divisions, and units, as indicating complete portions of a whole. That whole being distributed on the various stations, and in home waters as desirable, to meet the ever varying eccentricities of international complications. The general tendency, since I last endeavoured to deal with the subject of Imperial organisation, has been to concentrate nearer home with a powerful connecting link between Channel and Mediterranean Fleets. List "A" gives the proposal in 1887. List "B" suggests what might be the existing distribution, and the other Diagrams give the composition of a unit, division, squadron, and fleet. (*See* Figs. 3, 4, and 5.) At the present moment we have sufficient "Fleet-ships" to form four complete fleets and a squadron; that is, nine complete squadrons, eighteen complete divisions, and we shall still have two spare units to fill up casualties. In 1909, supposing that the present programme is carried out, we shall have five complete fleets, or, on the assumption that spare units are necessary, we shall have six spare units to take the place of those sunk or disabled in our present force of four fleets and a squadron.

LIST A.—1887 PROPOSAL.

A.	Commissioned Reserve—Two Squadrons—Fleet of	12	27 First-class Mastless Rams.
B.	Mediterranean Squadron and Division	9	
C.	Channel Squadron	6	
D.	West Indies Squadron	6	28 First and Second-class Ironclads or Cruisers as most suitable.
E.	Pacific Division	3	
F.	Australian Division	3	
G.	East Indies „	3	
H.	China Squadron and Division	9	
I.	S.E. Coast of America Unit	1	
K.	Cape and West Coast Division	3	

L. First and Second-class Cruisers.
M. Armed Merchant Steamers.
N. Convoy.
O. Obsolete for Sacrificing.
P. First-class laid-up Reserve, one to every Division afloat.
Q. Building.
R. Remainder in Reserve.
S. Imperial Troopships.
T. Transports on Hire.
V. Ocean Volunteer Force.
X.
Y. Colonial Forces.

LIST B.—1906 PROPOSALS.

Distribution of Force.

A.	Round Coast and North Sea, 3 squadrons ..	18	Fleet units.
B.	Channel, 2 squadrons	12	„
C.	Atlantic, 3 „	18	„
D.	Mediterranean Squadron and Division ..	9	„
E.	Pacific Division Cruisers	8	Cruisers.
F.	Australia „ „	3	„
G.	East Indies „ „	3	„
H.	China Squadron Armoured Cruisers	6	Armoured Cruisers.
I.	Cape and W. Coast Division Cruisers ..		Cruisers.
J.	S.E. Coast of America unit	1	Armoured Cruiser.

K. Armoured Cruisers, patrol duty.
L. Other Cruisers, patrol duty and fleet duty.
M. Armed Merchant Steamers.
N. Convoy.
O. Obsolete for Sacrificing, Blocking Harbours, etc.

'. Laid-up Reserve to replace Fleet ships after Destruction of Opponent's Fleet ships.

). Building.

t. Launched and completing.

). Small Craft.

:. Transports on Hire.

J. Under-water Vessels.

/. Ocean Volunteer Ships.

C.

/. Colonial Force ?

With reference to lists "A" and "B" it is necessary to point ut that I am confining my observations to-day to the organisation of 'Fleet-ships," but such armoured cruisers as could be spared from rotection duty, organised independently in squadrons, would require somewhat similar arrangement for their fuel and ammunition supply o that proposed for "Fleet-ships," so that they would be prepared to o-operate with any fleet should such co-operation become necessary. Cruisers attached to "Fleet-ship" divisions would have to be provided or by the divisional supply organisation, and there is no doubt that ome cruisers will have to accompany the "Fleet-ships" to protect he auxiliaries from cruisers or destroyers, while the main action is eing decided.

Composition of Fighting Fleet.

In 1887 I stated that the only question then was "the getting together of so many vessels with their guns and rams to form a fighting fleet; but every day the reasons for adjuncts and auxiliaries are forcing themselves on us, and their existence renders a new and systematic organisation imperative. . . ."

I concluded the paragraph by saying: "I propose to deal with the composition of a fleet prepared for immediate action, and I hold that all divisions, squadrons and fleets should be so prepared at all times—the component parts, 'parent, children, adjunct, and auxiliary'—for opposition to the hostile force, from whatever quarter it may come, being complete and prepared as a whole, so as to be ready for immediate muster at a given rendezvous."

I repeat, and beg to accentuate, the same words to-day. The absolute necessity for having your coal or liquid fuel and ammunition supply under your thumb is far more vital now than it was twenty years ago. The importance of the means of filling up on the spot after an action with the whole or a portion of the opponent's force cannot be exaggerated. Rapid recuperation is now more than ever essential.

I will recapitulate in detail what I proposed and still propose as indispensable in the composition of future fleets.

First.—I propose to give the term "fleet" a definite numerical value and strength which I fix at twelve units, adding a squadron or second fleet when it becomes necessary or advisable to mass an overwhelming force for the purpose of intimidation or action on a given spot. Taking the available "fleet-ships" into consideration, and also the auxiliaries, upon which we could put our hand, and looking to facts and conditions as they stand, I am convinced that the best

numerical composition for Great Britain at the present time is, as I have repeatedly stated, in divisions of three units, two of which would form a squadron, joining up as many squadrons, with adjuncts and auxiliaries complete, as became necessary for the successful fulfilment of the required effort. Having proposed the number of units that should form a division, squadron, or fleet, I will now venture to lay down what I consider these units (Fig. 3) should consist of:—

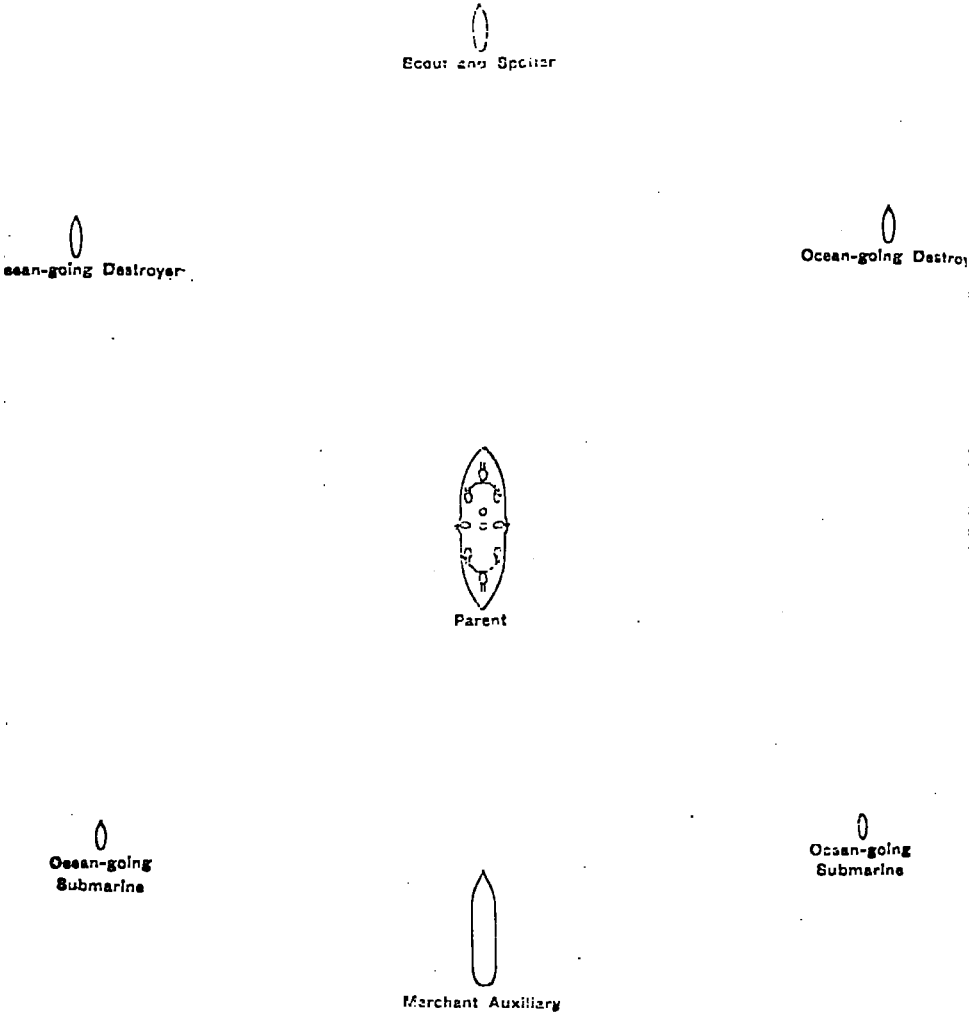
1. A "fleet-ship" as a base, which is merely a convenient name for what is variously spoken of as a "line-of-battle ship" or "ship-of-the-line." She should be of the highest speed and most piercing gun power, having one or two telescopic signal masts for semaphore and wireless communication, net defence, and an adequate number of protected Q.F. guns, and two captive balloons.
2. Two ocean-going swift destroyers, commanded by two of her lieutenants and manned by crews belonging to her complement.
3. Two ocean-going submarines, similarly manned and commanded.
4. A fast turbine scout, mine remover, fitted with apparatus for removing mine-fields, commanded and manned as before. She would act as lookout vessel when cruising and spotter in action, and always precede her parent when entering and passing through channels.
5. A merchant auxiliary carrying fuel, ammunition, stores, etc.

A Division (Fig. 4).—Every three units, when joined up as a division, should have definitely belonging to them, and for their sole use, the following auxiliaries:—

1. Two well-found and specially fitted fuel ships capable of carrying at least 6,000 tons of fuel each, one of which would always be on duty with the division, while the other is at the fuel depôt filling up. These fuel ships cannot be snatched up haphazard on the spur of the moment, and after their shoots, hatches, and winches or tanks have passed a rigid inspection they should be told off, lettered or numbered, and their captains given some insight into the manner in which a large force is moved on the open sea.

   Speaking generally, there should never be less than two thousand tons of coal, or its equivalent in liquid fuel, present with the force for each fleet unit.
2. A large merchant steamer with high speed and great cargo capacity to act as general store and ammunition ship, carrying boom gear, cartridges and projectiles, and fitted with accommodation for sick and wounded.
3. A torpedo and submarine depôt and telegraph construction ship, for laying and picking up electric cables, etc., carrying half the squadron complement of fitters, spare torpedoes, and electric cables. She should also be fitted with sick quarters and carry a medical staff.

PROPOSED FLEET UNIT



UNIT ORGANIZATION

FIG. 3.

In 1887 I suggested a powerful tug for each division, but I am now convinced that the work of towing disabled ships out of action, if such a feat were possible, would be better performed by the attendant cruisers, and I have therefore left the tugs out of this proposal. This force, with their respective scouts, destroyers, and submarines, would form a division under a rear-admiral or commodore.

The Composition of a Squadron.

The composition of a squadron (Fig. 5) should allow of its being more complete, but in the interests of perfect organisation and economy, it should be as nearly as possible double that of a complete division, gaining a saving where dovetailing is possible.. I would therefore suggest:—

1. Four fuel ships of 6,000 tons capacity, two always with the squadron, having the same qualifications as before mentioned.
2. A large, fast spare ammunition ship, having on board a proportion of cartridges and projectiles of the calibre of each unit. She must have capacity, as owing to the greatly increased weight of guns and limited reserve of buoyancy, the ammunition-carrying power of the "fleet-ship" will be severely felt in the future, and I look upon the spare ammunition ship or ships as next only in importance to the fuel ships. Take for instance our latest launched fleet-ship, the "Dreadnought" and her class, with a combined metal and powder discharge of half a ton per heavy gun. Notwithstanding their displacement and carrying power, they would require ammunition handy after bombardment or fleet action.
3. A large fast torpedo depôt ship of same capacity, with mines and spare torpedoes, carrying caissons and pontoons and all gear ready fitted connected with the laying of protective booms, and six mining launches. She would also carry such proportion of powder and shell as could not be carried in the ammunition ship.
4. A large liner fitted as a hospital ship, carrying the red cross by day and the electric cross by night, whose special and only duty would be to take on board all badly wounded and serious cases, and with the assistance of her tenders to pick up the crews of any "fleet-ships" that may have been sunk or set fire to. She would carry numerous steam hospital boats, and have a sea-going tender. If possible no sick or disabled men should ever go into action.
5. A telegraph construction and electric cable laying ship for picking up, laying, and tapping cables, etc. She would carry in her tanks cables of all sizes required for submarine mining, utilising spare space for carrying spare stores to meet all possible requirements of the squadron, and six mining launches.
6. A depôt ship for ocean destroyers and submarines not apportioned to the units. She would also carry the observation balloons and gas cylinders or plant for making gas, and aëroplanes and air-ships when perfected.

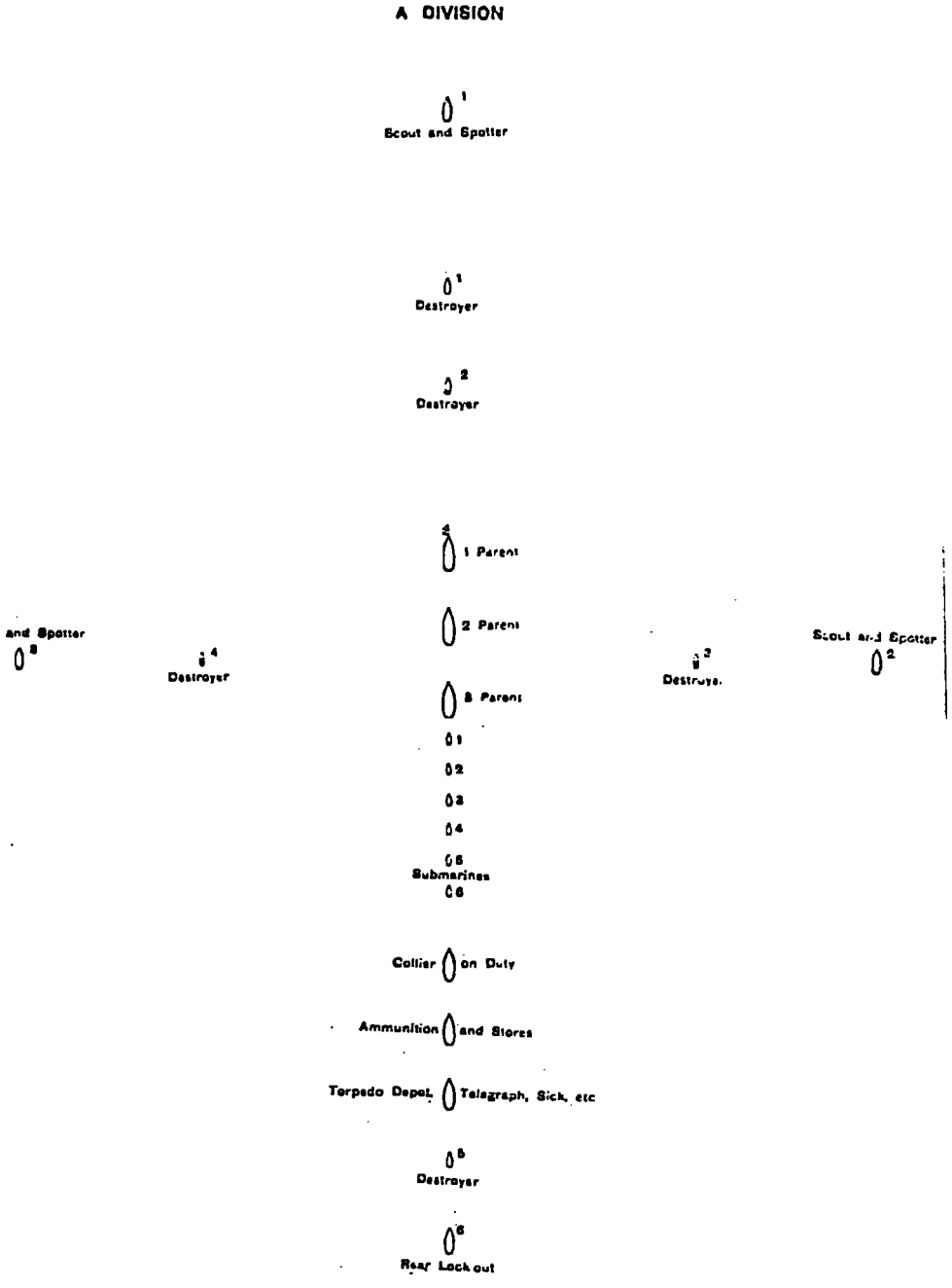


FIG. 4.

Each of these auxiliaries would take charge of the boats belonging to the fleet-ships during the action, hoisting them inboard if necessary.

It will thus be seen that for every parent or base there will be two destroyers, two submarines, and one mining scout or look-out vessel and spotter, and one large merchant auxiliary.

A Division.—Three units, *i.e.*, 6 destroyers, 6 submarines, 3 scouts, and 3 merchant auxiliaries, and 3 parents.

A Squadron.—Six units, *i.e.*, 12 destroyers, 12 submarines, 6 scouts, and 7 merchant auxiliaries, and 6 parents.

And a "Fleet" (Fig. 6).—Two complete squadrons joined up, twelve units, *i.e.*, 24 destroyers, 24 submarines, 12 look-out vessels, and 14 large merchant auxiliaries, and 12 parents.

This force would be capable of changing its locality at high speed. In addition to the unit adjuncts for defence, a torpedo flotilla will be required to act independently as a separate command. They would travel with (and assist the cruisers to defend) the auxiliaries from cruiser attack during action—one, two, or three to each, according to the number that could be spared from the combinations of the main attack. This composition can go any length, and you could, if absolutely necessary, mass your five fleets complete.

In 1887 I concluded the article on the composition by saying: "In my opinion the tendency in the immediate future will be to increase the adjuncts and decrease the number of parents."

I was, in this case, a bad prophet. The extraordinary increase in gun power and accuracy of shooting has brought about a contrary result, and so long as the gun maintains its present overwhelming position, we may safely predict that the only indispensable auxiliaries are: the fuel-ship, the ammunition-ship, and the hospital-ship, together with sufficient cruisers and scouts to allow of an efficient system of look-out.

Command and Responsibility.

Fleet organisation need not be changed. It still means the distribution of your force in the most compact form, marking the grades of command and responsibility at distinct points.

For instance, in the proposed fleet, the lieutenants or warrant officers in command of adjuncts would be responsible to their captain, who would, in his turn, be responsible for them and all connected with his unit, to the divisional commodore or rear-admiral, who again would be responsible to the squadron vice-admiral for all connected with his division, who would again be responsible to the commander-in-chief for his squadron. The commander-in-chief being, of course, responsible to the Admiralty and the country for the well-being of his fleet.

"In 1887 I proposed that every captain in command of a division should *de facto* become a commodore, or the rear-admirals' list be largely augmented." The latter suggestion has been adopted, and we have now sufficient admirals for the five fleets, ten squadrons, or twenty divisions, which would require, five admirals or senior vice-admirals, in supreme command of fleets, five vice-admirals or senior rear-admirals, in command of squadrons, and ten rear-admirals or commodores, in command of the remaining divisions.

The proposed composition of fleets, squadrons, divisions, and units is based on the assumption that recuperation (next after gun

power and accuracy) is the most important factor in naval warfare to-day.

I wish to place a wide gulf between the composition of a division, squadron, or fleet, and its tactical formation for battle.

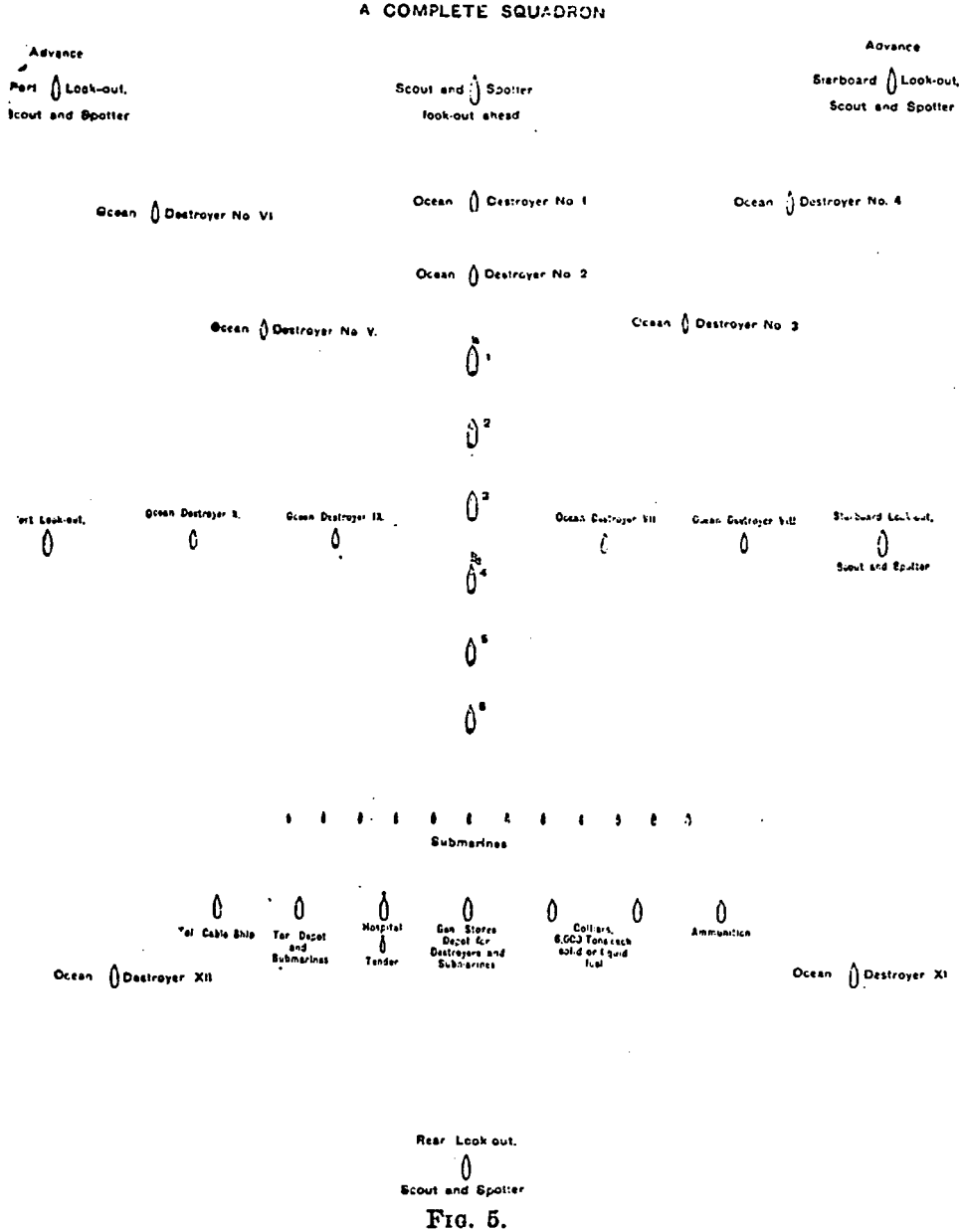


FIG. 5.

The first should be definitely laid down and prepared long beforehand, is probably now prepared. But to the admiral in command must be left the manipulation of the force for which he is responsible

to the country. In 1887 I stated: "We have yet to learn the most suitable and successful formation for attack and defence," and I advocated "perfection in all systems, and rapid changes from one formation to another."

Gun power and accuracy have again come to the rescue. The single line ahead has been proved and accepted by all to be the one possibility of a successful fleet action. Wheeling for a necessary change of direction, and altering course together when necessary, to take ground to the right or left. The single line has, in addition to its effectiveness for concentration of gun fire, the advantage of being the most simple and easiest kept of all formations, and requires the minimum of signals.

I now state without fear of contradiction that there is no known formation which the opponent could possibly take up, that would not place him at an overwhelming disadvantage when pitted against the single line ahead.

Therefore, it is clear to my mind that all systems of groups, pairs, double columns, bow and quarter lines, and other formations, some of which I have advocated in days gone by, are obsolete and useless. And why? Again, I say, owing to the overwhelming supremacy of accurate heavy gun fire.

All that it is now necessary to master is the art of following your leader in single line ahead without signals, taking ground to the right or left, by order, when an increase or decrease of range becomes advantageous—some simple form of altering course sixteen points together, completes all that can be required.

Peace Routine and Exercises.

I gave a large share of the space in the 1887 paper to the proposal for new routines and exercises consequent on the suggested removal of the yards and sails which I omit to-day, as it is needless to take up your time with a question which has long been included in the category of decided issues. But the principle remains the same. "The smartness, order, and also the comfort, of energy, force, no matter of what it is composed, still depends almost entirely on its system of routine and exercises, the arrangement of which should insure that the largest possible number are at all times receiving the utmost amount of instruction and benefit from exercises that will be of the greatest use to them when they have to assist in the numerous and different kinds of operations which the Royal and Mercantile Navy will be called upon to perform in any war sufficiently serious to endanger the safety of the Empire; and, at the same time, bringing no heavy strain on any body of men or portion of time. . . ."

The nature of the required instruction points to the development of the training class system, and assimilating the drills, aiming, and target practice, etc., to the home gunnery school courses.

Lay down your routine and drills, with a view to giving all hands the best chance of becoming S.G.T. Except ordinary educational subjects, nothing should be taught that is not connected with the protection of the fleet and the destruction of the enemy. In these divisions and squadrons, the criterion of smartness and efficiency will be the time taken to lay a minefield, build a boom, countermine a channel, out and in net defence, landing party complete, etc., and above all, the preparation of the ships for battle in every detail; and

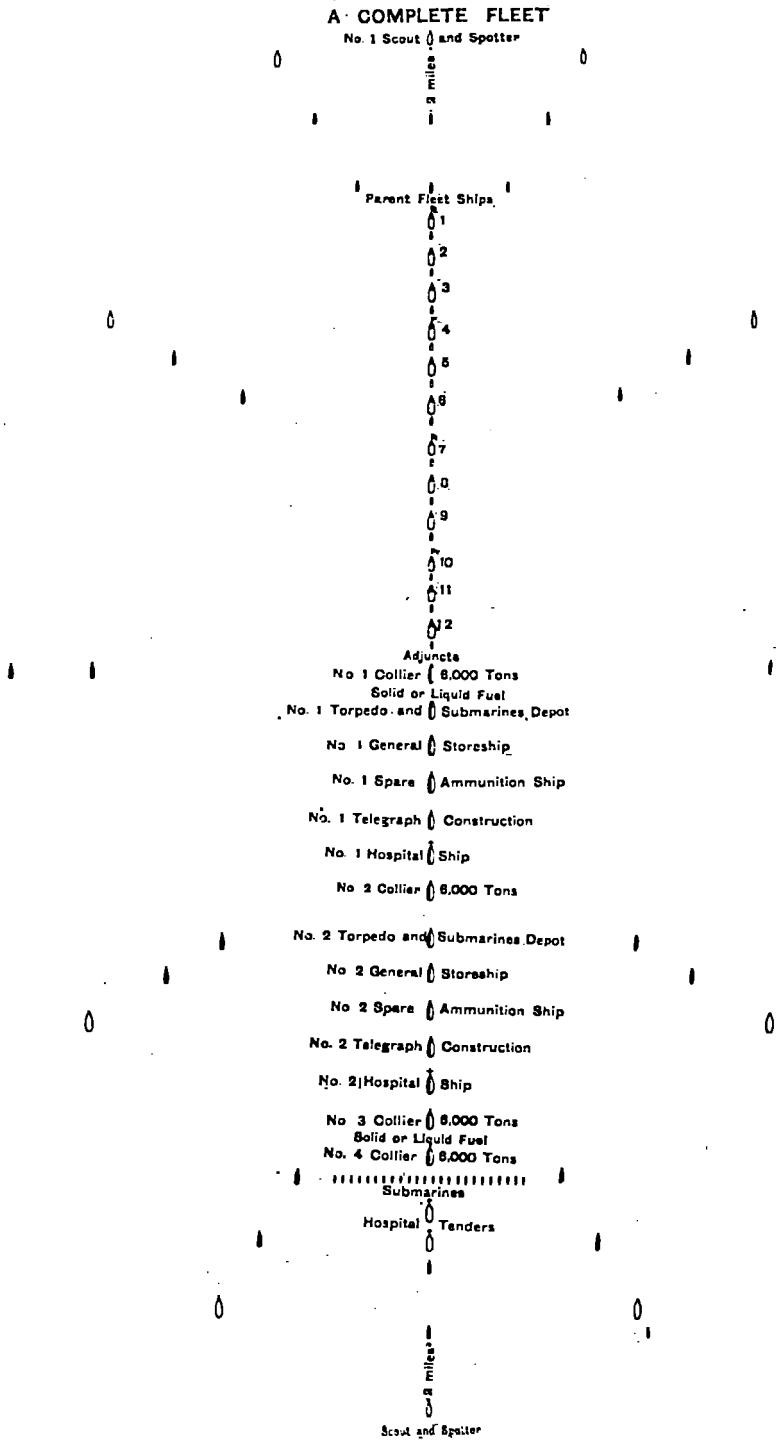


FIG. 6.

a system of exercise practice instruction, which would insure that every man who (through casualties or other causes) may possibly become a "gun layer" would prove to be as perfect a shot as can be made.

Practice in peace what you would have to do in war. We know that the result of a fleet action will entirely depend on the ammunition expended doing a relative amount of damage. Tries are of no value, and it is only goals that count in this game.

Practice is the one and only means of attaining perfection. There is no such clear proof of the result of practice as in "out-and-in net defence." In 1886 fifty minutes was considered a smart time; in 1906 fifty seconds is considered fairly smart.

The continuous supply of cartridges and projectiles in action is one of the most important minor details, and must be duplicated or triplicated, to make as certain as possible that the supply will be equal to the demand, and will be forthcoming, so as to insure delivery at the gun, up to the very last charge and projectile.

Hydraulic or electric lifts, backed by hand gear as a last resort in the case of a breakdown, would seem the most suitable method under present conditions. Our principal difficulty is, that while power and accuracy of concentrated gun fire, with speedy recuperation, is the one important factor to-day, that will decide a fleet action, there are numerous other functions, such as the destruction of forts, mine fields, etc., which would tax the skill and energies of the officers in command, and that is the principal reason why I have advocated, and still advocate, auxiliary carrying power, so as to place all requisite material at their disposal.

For the reason already mentioned, I have omitted the portion of the former papers devoted to sea routine, but notwithstanding the adoption of the line ahead for action, we require to thoroughly exercise the fleet in precise manœuvres, anchoring, weighing, inverting, etc., and we must still exercise the parents, adjuncts, and auxiliaries to move in concert and carry out previously planned, combined operations. At least once a year, and for a period of not less than a month, the whole station force, or in case of the Atlantic, Home, and Reserve, the combined force, should muster and go to sea complete for war and carry out battle practice, one fleet against the other. During this time the manœuvres cannot be too real, and even risks must be run in order to insure high tactical training and skill, and all filling up of ammunition, fuel, and stores should take place at sea. I still adhere to the statement that the probability of the superior officers being killed in the early part of the action, and the certainty of ships being sunk or disabled, necessitates the establishment of a system of filling up casualties while at general quarters (as at gun drill), both in ships and officers. To make it entirely chance work the names of the ships, admirals, commodores, and captains, and name or rating of all commissioned officers, should be printed on cardboard discs, and placed in a bag on the poop of the flag-ship. During combined manœuvres, they should be constantly drawn, and the ships or officers drawn, ordered off duty by signal, the next in command taking the place of his superior, and if he should be the senior executive left, becoming responsible for everything connected with the ship. In 1887 I advocated the flag-ship changing her place on the disablement of the commander-in-chief; under present conditions no change would be possible—above all

things the line must remain unbroken, the places of ships driven out being immediately filled up by the remainder closing up.

For my former statement, that "the force should be constantly exercised in filling up with coal at sea," I wish to substitute: "Fresh supplies of fuel should always be taken in at sea, and never in harbour."

Look-out and Communications Under New Conditions.

Wireless communication means a large extension of your system of look-out, and with swift cruisers and scouts commanders of divisions, squadrons, or fleet should at all times know, not only where their friends are and what they are doing, and going to do, but also where the whole, or different parts of the opponents are, and what it is probable they are about to do.

We may fairly come to the conclusion that surprises, while they must be guarded against by an extended system of fleet look-out by scouts and cruisers, are not nearly as likely to be as successful as they have been considered by nearly every writer who has attempted to deal with this subject. But that is only one side of the necessity. The real aim of scouting and wireless is to find and come into contact with the adversary should he put to sea. History teaches us that this has always been an almost overwhelming difficulty.

Two factors in the problem have changed the conditions: distant communication, and rapid transportation of a force, quite independent of the wind and sea.

It should now be much less difficult, given that the opponent puts to sea, to find him, and bring him to a decisive action. The development of the air-ship will greatly add to the possibilities of obtaining accurate information, and besides their destructive power, they will be invaluable as scouts.

Rapid commissioning, though it should be instantaneous when necessary, is not so important, now that all ships that are in the first line are either in commission complete, or with nucleus crews.

Two principles seem to me to have been developed since I last had the honour of addressing an audience in this Institution: one; the getting rid of obsolete and useless hulks; and the other, the general preparedness for striking a blow, almost before the word.

The announcement of the declaration of war should include in the same paragraph the news that the adversary's main fleets have been sealed up or destroyed.

The strategical improvement in this connection has hardly yet been realised.

Unit Complement.

Taking into consideration the rapid growth of mechanism, and the numerous uses it is put to, which will increase rather than diminish in the "Fleet-ship" of the future; and also the reduction of guns' crews, notwithstanding increased gun power, it does not appear that the complement of a complete unit need greatly exceed that of the present "Fleet-ship," the increase being in specialist officers and reliable torpedo boat coxwains, gun layers, sight setters, etc. Here we are again helped by the fact that the general service officers and men are gradually dying out, and the gist of the education scheme is, that everyone will specialise in some form or other.

The unit crew should not greatly exceed five hundred all told, with ten per cent. of officers for all purposes. The ideal officer who will keep the forenoon on deck, the first in the engine room, and visit the sentries between whiles, while he drills his gun compartment and attends to the bags and bedding of his division, will have, it seems to me, just enough to do to keep him out of mischief. When the boilers and funnels go, they will, as a natural consequence, take a large proportion of the engine-room complement with them.

Boom Defence.

The enormous advance that has been made in the protection of our home and colonial ports by breakwaters, has, to a certain extent, reduced the necessity for carrying ready-made booms; but there are still many harbours of refuge where such a precaution would add greatly to the safety of the fleet, while taking a short rest for recuperation of figthing efficiency, and also for the worn-out officers and men. The boom would be carried by the auxiliaries in sections, and each unit of the force present would assist to reeve the hawsers.

The boom would consist of cellular caissons or pontoons, connected by large cellular built nun buoys, spreading six large flexible steel wire hawsers, interlaced with small short steel wire, with torpedo nets, carried by the store ships for that purpose, hung so as to stop submarines; the moorings and centre weight being supported by large buoys, between one and two fathoms below water. Besides defending the entrance to a harbour, this boom might also be laid to bottle up the adversary's destroyers or submarines, who had taken refuge in one of their ports, and so prevent them from making night raids on a blockading force.

Speed as a Factor.

Side by side with the increase in tonnage and gun power has come the increase of speed in the "Fleet-ship."

Notwithstanding that the advantage of high speed is severely criticised by an anonymous writer in the February number of *Blackwood's Magazine*, I place a very high value on the speed of the "Fleet-ship," and for many reasons. First and foremost, it is important, whether you use it or not, to have the option under adverse circumstances, such as overwhelming odds, etc., to force on, or stave off, an action instead of your opponent having that option; and secondly, in action tactics, with superior speed you may gain an advantageous position; with inferior speed you never will.

When the fleets are evenly matched in speed, the desirable T position will be extremely difficult to gain without dividing your force, but it can only be accomplished by having relatively high speed as compared with the opponent.

Speed again is necessary, in the event of a portion of the adversary's force declining to continue the action, in order to insure fully attaining the object of all naval battles, namely, the complete destruction or capture of the opponent's ships; and lastly, speed is the only element in the equipment of a fleet which will enable you to find your antagonist, and bring him to action.

Therefore, I state unhesitatingly, that high speed in a "Fleet-ship" is all important, and especially in the case of our most recent

addition to the fleet, where the gun power has increased in a greater proportion than the speed.

Whatever the "great possibilities of doing mischief because he does not understand" (which the *Blackwood* writer ascribes to the Whitehall autocrat) may consist of, at least we may be sure that, whoever the "Whitehall autocrat" may be, he deserves well of his country for having increased the speed and gun power of the "Fleet-ship."

I will conclude this portion of my subject by summing up the requirements conducive to the success of a "fleet action," gun power, control and accuracy of fire, protection, speed, capacity and recuperation, no top hamper, no boats.

Position.

An adversary is feared and respected in proportion to the awkward position, from your point of view, in which he is clever enough to place you. Wellington's high opinion of Marshal Soult was based upon the fact that before going to bed he used to think over various plans which Soult might carry out during the night, and he invariably found that the Marshal had adopted the one which he (Wellington) disliked the most! So that in discussing the pros and cons of a fleet-action, it would seem to be the wisest plan to place the opponent in the position you would least desire him to take up, and that is probably the position you wish to adopt. Undoubtedly the T position is the one to attempt above all others, but it is improbable that either side can gain it with equal numbers, and you must be fully prepared for a position which you have reasonable prospects of taking up. Therefore is is clearly the policy to build, organise, equip, and train so as to have a decided advantage (in the more probable II—double I —position) in power, accuracy, and practised method of concentration.

It is only when in possession of preponderating force that you could attempt an attack from two or more directions; but with the strength which it is necessary for the safety of the Empire that we should always have at our command, you could make certain of having a fleet and squadron of "fleet-ships" or a fleet and squadron of armoured cruisers against any possible foreign combination on any given spot, and in that case you could keep your fleet intact abeam of the adversary, and cross the T with your spare squadron. With these odds (which we ought always to have at command), together with accuracy of gun fire, the annihilation of the adversary should take but very few minutes, which accentuates Napoleon's definition of the object of all strategy: "Reunir plus de monde que l'enemie sur un point donnée."

The Approach.

The best formation in which to cruise when you expect to meet the adversary is important. Your scouts should supply you with his numerical strength, formation, and course.

It would appear that "line abreast," auxiliaries ten miles astern, would give you an advantage, especially in thick weather. From that position you can quickly turn eight points together into line ahead when at your best range, and if the opponent is approaching in line ahead, end on, you gain the T position at once. If you approach

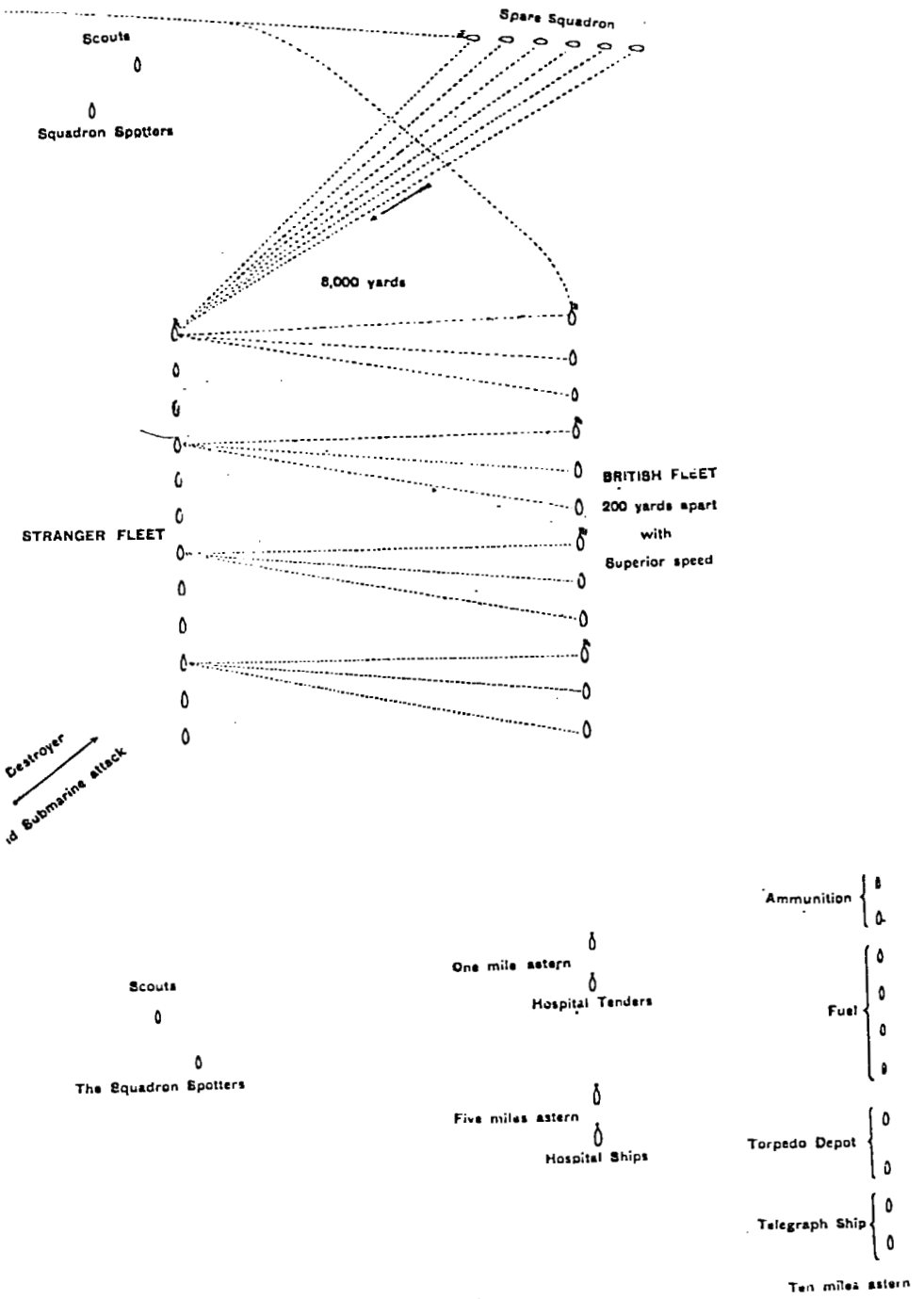


FIG. 7.

in line ahead you give the opponent the chance of meeting you with his line at right angles to yours, ahead of you, and so place yourself in the worst position.

I would therefore suggest that the best formation for approach before opening fire is "line abreast," forming line ahead and down masts as soon as you reach your accurate firing distance.

You would thus gain an advantage in thick weather and not lose it.

Concentration.

There is nothing new in the system of concentration, either in land or sea battles. It is an accepted axiom, and we have only to investigate the best method of applying the principle to a fleet action. In the event of our being fortunate enough, owing to fog, mist, or rain, to cross the T, we should of course concentrate on the leading ships, and so on down the line; but in the more probable contingency of the adversary being in line ahead on our beam, the question arises for discussion as to the number of ships required to concentrate on a given opponent, so that his fleet shall be destroyed one by one, two by two, three by three, or four by four, in the shortest possible time.

The conclusion I have arrived at is that it lays between three by three and four by four, and it seems the most natural that a division should undertake the destruction of its opposite number; therefore the 1st division should direct its concentrated fire on the leader of the opponent's line, then on No. 2, and then on No. 3; the 2nd division on No. 4, then 5 and 6; the 3rd division on the leader of the 2nd squadron, and then on Nos. 8 and 9; the 4th division on No. 10, and then on Nos. 11 and 12 (Figs. 7 and 8). Of course, a great deal would depend on the gun power of our fleet. A fleet of "Dreadnoughts" might concentrate two to one on weaker opponents, so that the commander-in-chief would be guided by the known comparative strength of the opposing fleet in giving his orders for proportionate concentration. I have drawn the concentration in the diagram at 3 to 1, but of course, as in all the points raised, it is open to your criticism and suggestions for improvement.

Range.

The question of range is of the greatest importance in a fleet action. It goes without saying that the ideal range is that at which you are sure of hitting every time, and the one object of all target practice should be, and is, to augment that distance, and so far as possible to gain a most valuable tactical advantage in that respect. The *juste millieu*, where you are certain and the opponent is only doubtful, is the range you would naturally adopt. For the sake of example I have used 5,000 yards, but with practised and reliable gun-layers I should adopt their utmost limit of certainty, whatever that happened to be.

Strategy.

Before summing up I beg to submit to the audience two questions of strategy, which, to my mind, have long been of vital importance to Great Britain, and which specially affect the distribution of "fleet power" for war and the transport of troops to or from the Continent

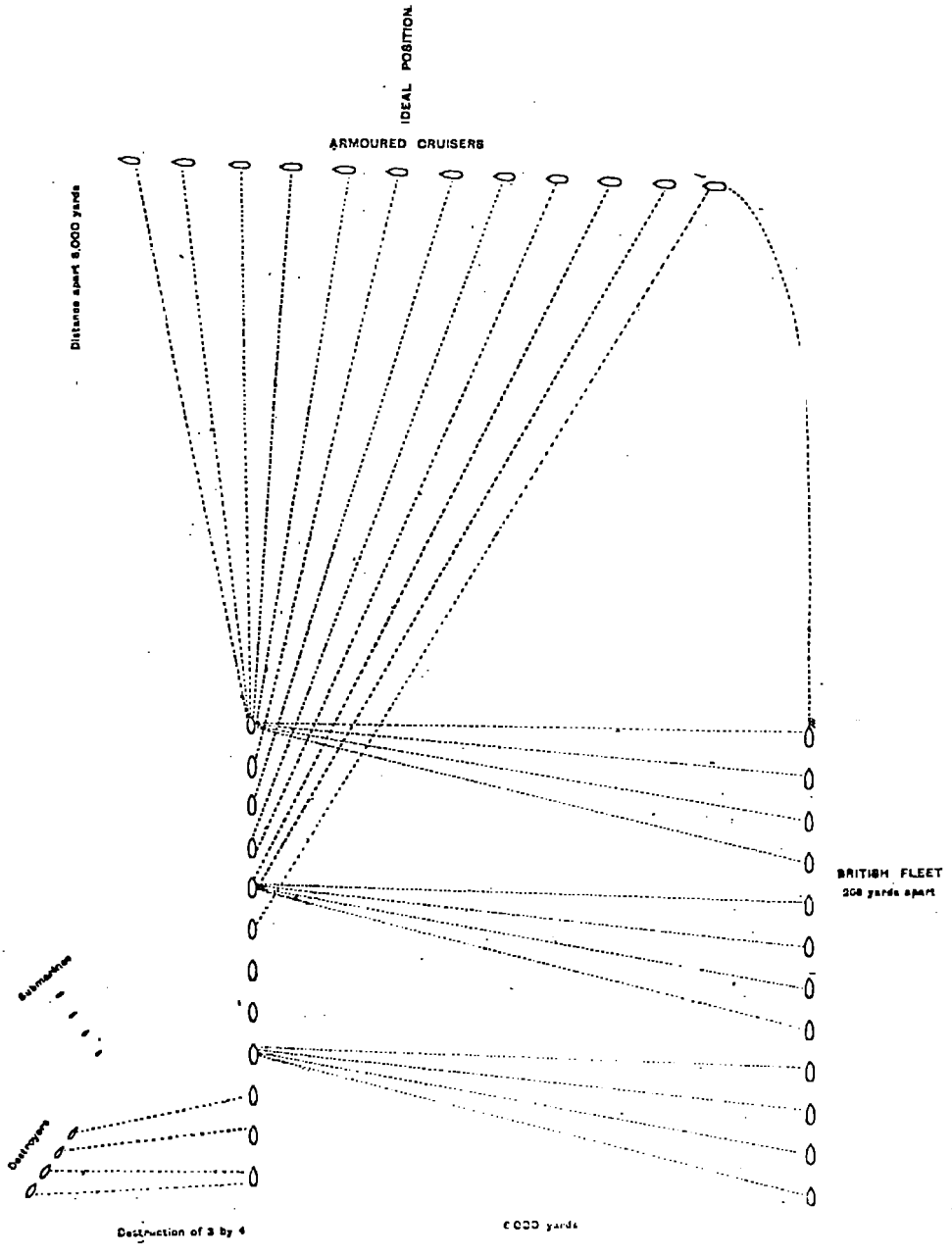


FIG. 8.

by other means than over-sea. I allude to the Edinburgh and Glasgow Fleet-ship Canal; and secondly to the Channel Tunnel.

To me it seems incredible that with the ever-increasing necessity for rapid concentration, either in the North Sea or round our coasts, we have no way of rapidly cutting across the centre! especially as the means are at our disposal, and would be of great commercial value, in addition to strategical importance. The same may be said of the second question, so long and largely discussed. The advantages are all on the side of the two countries which it would join in an increasing bond of union, and should the present *entente* continue, which I hope and believe will be the case, both countries will have transport under-sea for mutual support. On the other hand, if an unfortunate difference should arise, which I trust will not be the case, either country would have the option of closing the tunnel in the time it takes to operate the handle of a sluice valve.

To sum up, I would lay down the following rules as vital for the success of a fleet action:—

1. To muster a greater number of "fleet-ships" than the adversary on a given spot, and to ensure recuperation at that spot.
2. By concentration and position to ensure the greatest number of projectiles hitting a given adversary in the shortest possible time.
3. To gain the position where the adversary can use his guns with the least effect, while you retain your full crushing power.
4. Keep your main fleet intact under all circumstances, detaching extra "fleet-ships," armoured cruisers, destroyers and submarines as necessary.
5. Prepare for the necessity of attacking the opponent broadside to broadside, crossing the T with extra force, and organise an independent attack on the opposite quarter by destroyers and submarines on weak points; shoot straight, and don't be put out by the concentrated fire of your opponent, or the sinking of a ship or two on your side. Use all your skill to keep your line steady.
6. Recuperate the moment the action is over. Tranship all wounded that can be moved, and fill up casualties from auxiliaries.
7. Generally speaking, think out and try to make use of the latest inventions up to the last moment, and by training do your utmost to obviate the necessity of making any but the most simple prearranged signals after the masts come down and the flag-ship opens fire.

In conclusion I beg to repeat that no one can regret more than I do that we cannot carry all we require on one keel, and to some it may be a matter for regret that our wants cannot be carried by ships whose officers and men belong to the Royal Navy; but we have to deal with facts. That we shall have a number of component parts—Royal, Reserve, and Volunteer—working together under sub-heads, who, again, are acting under a supreme director and organiser, is a

fact which is brought home to those who study the subject. This means, as Sir Donald Currie pointed out years ago in a valuable paper on maritime warfare, "*Preparation long before wanted.*" It means that a combined and systematic organisation of our gigantic Royal and Mercantile naval resources is imperative, and from what we hear, we may assume that it is making rapid progress.

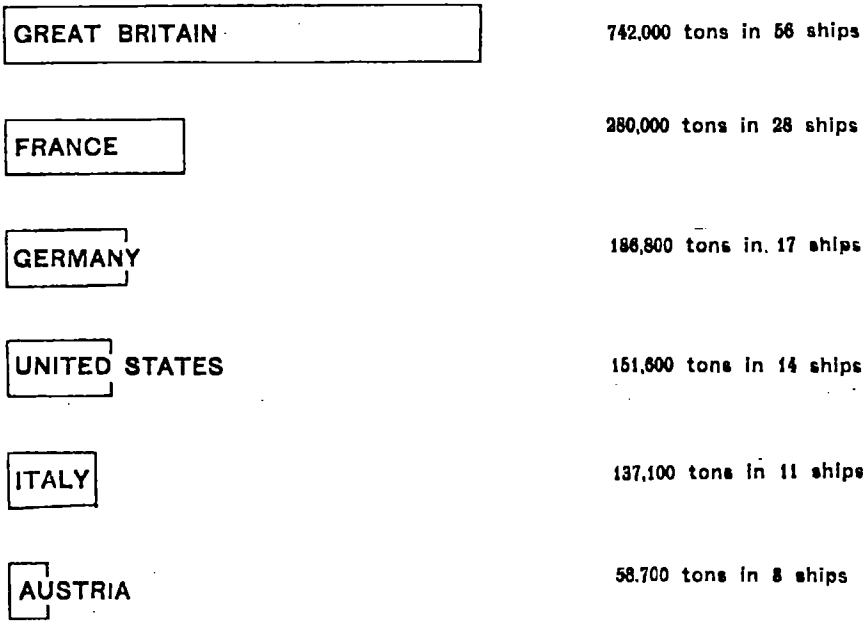
> "Systems in his perception roll,
> Whose all-informing mind directs the whole."

When I last wrote on this subject there were many dismal prophecies as to the deterioration of the British seaman owing to the loss of the sails and consequent drill aloft. What is the result? We have produced the real seaman-gunner and gun-layer. The man whose business in life is to load quickly and shoot straight. As is the case in all communities, the necessity of the hour has produced the man.

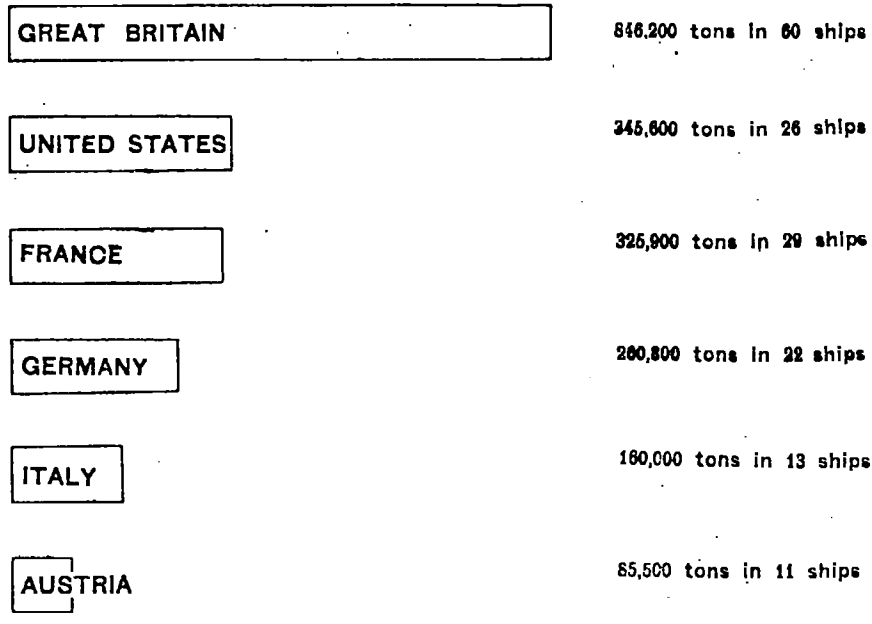
Get rid of masts, funnels, and boats, as targets courting disaster, and, as I said in 1887: "Leave only a boat-hook on which to hoist the Union Jack, and depend upon it when the time comes its spots of glory will rival those of past ages, or it will wrap itself as a shroud round the ships and crews, who may yet go down with their colours flying."

ROUGH ESTIMATE.

1905 BATTLESHIPS READY.

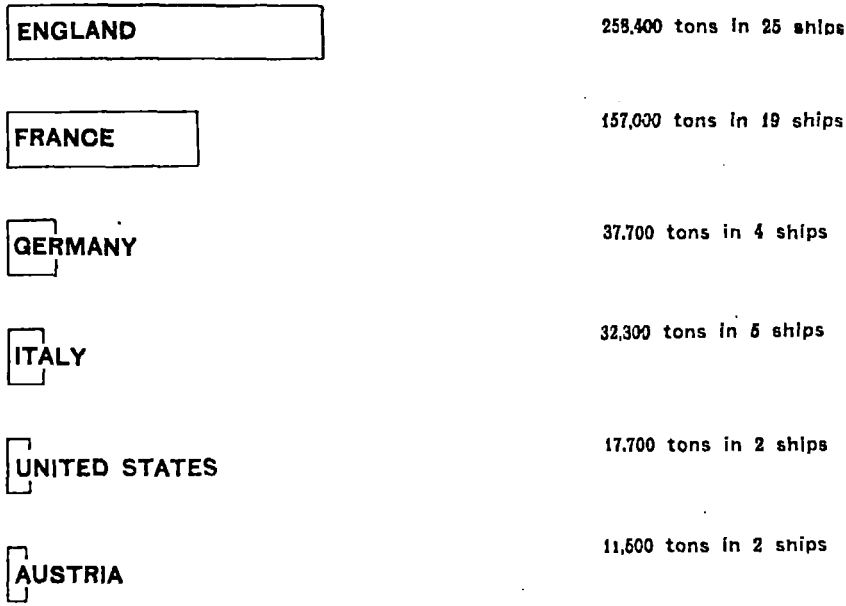


1909 BATTLESHIPS READY.

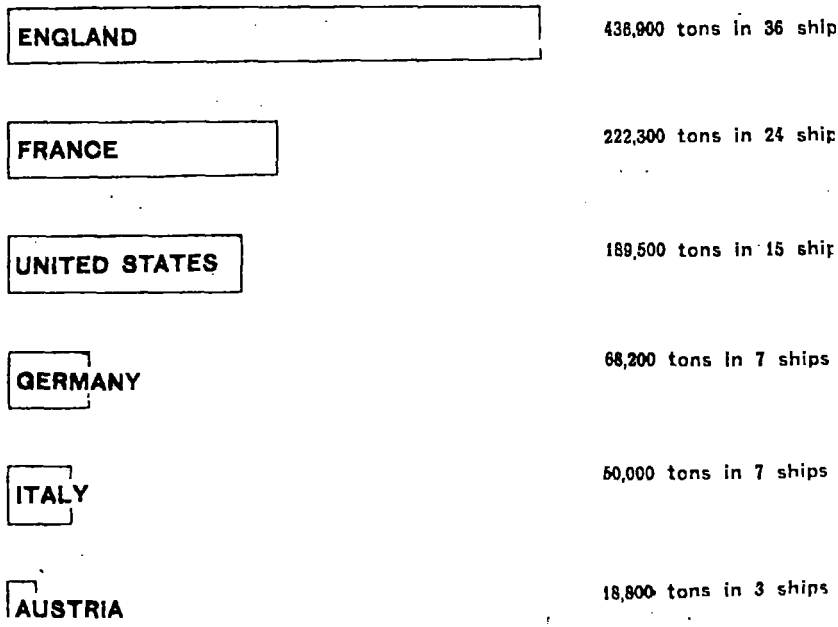


ROUGH ESTIMATE.

ARMOURED CRUISERS, 1905, READY.



ARMOURED CRUISERS, 1909.



Admiral Sir ROBERT H. HARRIS, K.C.B., K.C.M.G. :—I think before I say a word about the paper, I should congratulate the Institution on having at last obtained a really valuable naval paper. The only fault that I can find with it is that it is too exhaustive. I also think it would have been greatly to the advantage of the Institution if it had been divided into, say three or four parts. Each one of those parts so ably dealt with by our gallant lecturer would afford full scope for a large discussion. To deal with the paper paragraph by paragraph on its great merits would be impossible in the course of this short half hour. Our lectures, as a rule, do not run over half-past four or five o'clock, and I fancy it is four o'clock now. I think I may congratulate the gallant lecturer on his prophecies. There is no doubt that the prophecies which he made twenty or thirty years ago have many of them been fulfilled. I suppose it is equally reasonable to say that some of those he makes now may eventually be fulfilled, though to my mind many of them are very strange. The balloons, for instance. I have no doubt that a balloon would be most valuable to a fleet as a spotter; but when you are steaming fifteen or twenty or twenty-three miles an hour, where is the balloon to be? That would be a puzzle to me. No doubt science may overcome much, but at present I do not think the use of balloons as indicated to be possible. Again, dealing with the abolition of funnels and masts—and a most valuable suggestion it is—no doubt funnels and masts ought to go if we can dispense with them; but at present the whole thing turns on the internal combustion engine which the lecturer has alluded to. Up to the present I understand nobody has succeeded in getting an internal combustion engine to go well over 500-H.P. As our ships now run up to 30,000, and probably will run up to 40,000-H.P., it will be exceedingly difficult for this combustion engine to catch the reciprocating engine up. It may do so. If it does, it will undoubtedly be a great advantage in every way, both as regards fuel and many other points. As regards the masts, I suppose we must still have some place to hoist our flags—the admiral's flag and the Union Jack. If you put them up in the balloon, when you are going twenty-three or twenty-five miles an hour, they will be half a mile astern or probably trailing in the water at that pace. No doubt the gallant lecturer has fully realised the value of the submarine, and no doubt the submarine has come and will stay, and it is on this internal combustion engine that the big submarine depends. At present you cannot have a very big submarine, because you cannot have a big enough internal combustion engine. If we really do succeed in getting a large ocean-going submarine she will undoubtedly be a terror on the seas. Probably she will not be a submarine—she will be a submersible vessel, which, though different, is practically the same thing. I will confine myself entirely to dealing with only the first page of the paper, and as there are probably many other gentlemen who would like to speak, I will not trouble you any further. I would, however, again express my regret that the gallant Admiral has not given us this very valuable essay of his —I call it an essay, really—in three or four portions, which we might have had the pleasure of listening to on three or four afternoons, instead of having it all in one afternoon.

Vice-Admiral W. H. HENDERSON :—I agree with Sir Robert Harris, that the paper is too exhaustive to attempt to criticise the large number of points raised by it, many of which are problematical, and will depend on future developments in invention, though some in the course of another generation will be far on the way towards solution. It is an historical

principle that the long-hitting weapon carries the day. The club gave way to the spear, the spear to the bow, the bow to the musket, and the musket to the rifle. Whatever is the longest range weapon must always be the one for primary consideration. I think each fleet-ship must be self-dependent; the more accessories can be got rid of the better; each class of vessel must have freedom to carry out its own special functions, and therefore each ship must have its own system of fire control. I feel certain control by other vessels will never answer. I am with the lecturer in his wish to get rid of everything that is useless, but proficiency of function must be maintained. The question of boats has been discussed over and over again. The Chinese left theirs behind, I think, in 1894. The point must be decided beforehand; they must be left at the base or risked; there will be no time to hoist them out just before an action, nor could a set of auxiliaries pick them up then, drifting about as they would be. I heard the other day that an American engineer is well on the way with developments for large internal combustion engines; but whatever changes we have, I do not concur with the lecturer that engineering or mechanical skill will be less in demand. All developments will require it of a higher order and in greater quantity. Lord Cochrane, I think it was, who proposed to destroy Cronstadt with balloons, but as yet we are as far off realisation as he was. Again, and finally, I do not think a fleet-ship can look after two destroyers, much less two submarines; they must have their own separate parent-ships. Whatever the organisation of a fleet may be, the battle-ship must have nothing to do with mothering flotilla craft; she has quite enough to do her own work and keep herself efficient, coaled, watered, supplied with ammunition and all other necessities. They will not be necessarily with the battle-fleet; the captain of a ship cannot be wandering about to look for them, or can his attention be given to children of this sort; but this need not prevent flotilla craft being temporarily attached to fleet-ships for special purposes when required.

The CHAIRMAN (Admiral Sir N. Bowden-Smith, K.C.B.):—As no other gentleman appears to wish to offer any remarks, I will now move a vote of thanks to Sir Charles Campbell for his paper, and also, on behalf of the Institution, beg to thank the two flag officers who have taken part in the discussion. Complaints are sometimes made that we do not have sufficiently up-to-date papers on naval and military matters, but on this occasion the gallant Admiral has not only given us an up-to-date lecture, but has travelled somewhat into the future. I do not feel competent to offer any suggestions on his proposed new methods of propulsion for ocean-going ships and consequent abolition of funnels and possibly coal, nor can I follow him in aerial navigation and the development of airships; but in these days we cannot look upon anything as impossible, when we consider what immense strides we have made in our means of communication by the aid of wireless telegraphy, and also the possibilities opened up by balloons or kites of increasing the range of our vision or getting a peep into an enemy's harbour. Quite recently, when on a tour in the West Indies, I was informed that Admiral Evans, of the United States Navy, had in his cabin on board the flag-ship two photographs of his squadron taken by a camera suspended from a kite, the shutter being worked electrically from the deck. One photograph was taken at an elevation of 500 feet, and showed the squadron at anchor in Hampton Roads. It was very clear, and showed distinctly the men on deck and pulling in the boats. The other was taken at an elevation of 1,200 feet

of the squadron under way, the kite being attached to the stern of the flag-ship. Although, as I have previously said, I am not able to follow the lecturer into the future, I will offer one or two remarks on existing problems to which he refers. I am glad to notice that the gallant Admiral expresses appreciation of the present strategical disposition of our fleets, which, in my humble opinion, has immensely increased our strength, though the massing together of such a large number of ships may appear a menace to some of the other Powers. He has alluded to the speed question, and I agree with him that it is of very great importance. You cannot increase the speed of a ship after she is built, whereas you can supplement her coal endurance by having cruising colliers with a fleet, and coaling at sea when weather permits. Maintaining the bunkers full is of such vital importance that coaling under way must be a constant exercise. I am aware that two flag officers, whose opinion deservedly carries great weight, have recently stated that high speed does not give the tactical advantage usually ascribed to it; but even if that is granted, it appears to me that in sea as well as land warfare it is everything to get to the right place at the right time. The want of speed might involve a disaster or the loss of an opportunity. No one would, of course, wish to see in a war-ship everything sacrificed to speed, as is the case in a scout or a destroyer, but I would earnestly hope that in the designs for future battle-ships, when all the compromises are considered, the value of speed will be recognised. I well remember several years since the alarm caused to some naval officers by the prospective total abolition of masts and sails, and the fear expressed that our seamen would in consequence deteriorate; but it has resulted in officers and men concentrating their attention on more important matters, notably rapidity of coaling and improvement in gunnery. It must be a gratification to all of us to notice the zeal and attention now given throughout the fleet to target practise, which are producing such excellent results. I am doubtful if the proposed ship canal between Edinburgh and Glasgow is of sufficient strategical value to justify the cost of construction, and one could hardly expect it to be a commercial success, as its length would, I think, be nearly double that of the Manchester Ship Canal. Personally I am not in favour of the Channel Tunnel, preferring to keep our "silver streak" intact. I beg to thank the Admiral for his paper.